

04/44/68/

SPECIFICATION

TITLE: ~~SIGNAL AMPLIFYING CIRCUIT IN CCD CAMERA~~

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a signal amplifying circuit in a CCD (Charge Couple Device) camera using an area image sensor for use in a device such as a monitoring video camera.

2. Background Information

Heretofore, as shown in Fig. 5, in a conventional CCD camera, a light signal passed through lens a is transduced into signal S<sub>1</sub>, by CCD sensor b. The signal S<sub>1</sub> is a sampling held in CDS c as signal S<sub>1</sub>, the signal S<sub>1</sub> is processed in processing circuit d and output from signal input part 1 as signal S<sub>2</sub> as shown in Fig. 6.

This invention relates to processing circuit d which is explained in more detail. As shown in Fig. 5, OSC (oscillator) 2 generates a synchronizing signal, timing generator 3 drives a CCD, V driver 4 is an iris signal S<sub>4</sub> output from processing circuit d for an automatic iris.

To obtain composite video signal S<sub>1</sub>, processing circuit d is constructed as shown in Fig. 7. Input signal S<sub>1</sub> is amplified to a predetermined level V<sub>1</sub> in AGC amplifier e and transduced into constant level signal S<sub>3</sub>. On the other hand, signal S<sub>4</sub> amplified in fixed amplifier f is output as a control signal of

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By: [Signature]

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1 a lens having an automatic iris or control signal for inputting  
2 a light limiting circuit.

3 Operation of above device is as follows:

4 Signal S3, AGC, amplified in AGC amplifier e is passed by  
5 low pass filter g, to remove a useless wide frequency component,  
6 passed through gamma correction circuit h, white clip circuit i,  
7 composite sync mixer j, driver k (matching to 75 ohm line) and  
8 output as a video output signal S2 shown in Fig. 6. In the  
9 composite video output signal S2, the S/N (signal to noise)  
10 ratio is set to more than 40dB(1%). This invention concerns the  
11 S/N ratio.

12 Problems to be solved by this invention.

13 If an object is illuminated by a sufficient light source of  
14 more than 0.02 lux, the S/N ratio is kept more than 40dB(1%) and  
15 no problems occur, but in low illumination such as night,  
16 photographing is impossible. However, in night photographing,  
17 it is desired to broaden the range of illuminating until 0.02  
18 lux under a wrong S/N ratio.

19 BRIEF DESCRIPTION OF THE INVENTION

20 This invention intends to eliminate said drawbacks, and an  
21 object of this invention is to provide a signal amplifying  
22 circuit in a CCD (Charge Couple Device) camera in which under a  
23 sufficient object illuminating conditions (normally more than  
24 0.02 lux) photographing normal circuit construction (Figs. 5 and  
25 7), while under a low object illuminating condition,

1 photographing while ignoring the S/N ratio, by inserting  
2 auxiliary amplifying circuit m or raising the amplification  
3 factor of AGC amplifier e.

4 Namely, in this invention when photographing at normal  
5 object illumination, the photograph is at a high S/N ratio and  
6 high grade, but when photographing at a low object illumination,  
7 the photograph is at high noise and ignoring the utility 20db  
8 S/N ratio (noise component 10%).

9 The detection means of said low object illumination is an  
10 output level of fixed amplifier f or lowering of the video  
11 output level (Fig. 2).

12 The above and other objects, advantages and novel features  
13 of this invention will be more fully understood from the  
14 following detailed description and the accompanying drawings, in  
15 which like reference numbers indicate like or similar parts  
16 throughout wherein:

17 BRIEF DESCRIPTION OF THE DRAWINGS

18 Fig. 1 ~~is~~ a block diagram of a first embodiment of this  
19 invention.

20 Fig. 2 (A) shows the relation of object Lux (abscissa) and  
21 video output voltage (ordinate) of a prior device (dotted line)  
22 and this invention. (B) shows the relation of object Lux  
23 (abscissa) and S/N ratio (ordinate) of this invention. (C)  
24 shows the relation of object Lux (abscissa) and gain of  
25 auxiliary amplifying circuit m (ordinate) of this invention.

1 Fig. 3 is a block diagram of a second embodiment of this  
2 invention.

3 Fig. 4 is a block diagram of a third embodiment of this  
4 invention.

5 Fig. 5 is a block diagram of a conventional CCD camera.

6 Fig. 6 is a graph of video output signal S<sub>2</sub>.

7 Fig. 7 is a block diagram of the processing circuit d in a  
8 conventional CCD camera.

9 DETAILED DESCRIPTION OF THE INVENTION

10 According to claim 1 of this invention, signal processing  
11 circuit d of a video camera using a CCD, area sensor etc. is  
12 increased in an auxiliary amplifying circuit m, the  
13 amplification degree of the auxiliary amplifying circuit m being  
14 raised according to necessity so as to maintain the video output  
15 voltage at a predetermined voltage and vary the amplification  
16 degree of the processing circuit d so that the range of  
17 photographing is broadened.

18 *inc*  
*B2* According to claim 2 of this invention, signal processing  
19 circuit d of a video camera using a CCD, area sensor etc.  
20 provides an automatic gain control auxiliary amplifying circuit  
21 m<sub>1</sub> of high S/N ratio, low amplification degree and automatic  
22 gain control auxiliary amplifying circuit m<sub>2</sub> of low S/N ratio,  
23 high amplification degree, according to necessity, it is  
24 possible to selectively use automatic gain control auxiliary  
25 amplifying circuit m<sub>1</sub> of high S/N ratio or automatic gain

1 *Agc* control auxiliary amplifying circuit  $m_2$  of low S/N ratio.

2 According to claim 3 of this invention, signal processing  
3 circuit d of a video camera using a CCD, area sensor etc. the  
4 function of said two automatic gain control auxiliary amplifying  
5 circuits  $m_1$  and  $m_2$  in claim 2 are included in one AGC amplifying  
6 circuit em which functions are switched by outer switching.

7 According to claim 4 of this invention, to detect the  
8 change of object illumination, the output voltage or the signal  
9 level in signal amplifying process is detected.

10 Embodiments.

11 First Embodiment.

12 Fig. 1 illustrates the first embodiment of this invention.

13 As shown in Fig. 1, in this invention, auxiliary amplifying  
14 circuit m is newly inserted between low pass filter g and gamma  
15 correction circuit h in a conventional circuit shown in Figs. 5  
16 and 7 which raises the amplification degree by detecting the  
17 variation in the video output voltage (Fig. 2). The  
18 amplification degree of the auxiliary amplifying circuit m  
19 changes from 0 dB to 20 dB.

20 Operation of above device is as follows:

21 In normal photography, the amplification degree is 0 dB.

22 AGC level detector r monitors video output signal  $S_2$  and if  
23 the image signal is lower than 0.72v, the output of level  
24 detector r changes and the amplification degree of the auxiliary  
25 amplifying circuit m increases.

1 By said feedback operation, the video output voltage is  
2 maintained at a regular voltage of 0.72v.

3 In the first embodiment, auxiliary amplifying circuit m is  
4 newly inserted between low pass filter g and gamma correction  
5 circuit h but may be inserted between gamma correction circuit h  
6 and white clip circuit i, or between AGC amplifier e and low  
7 pass filter g, or between signal input part 1 and AGC amplifier  
8 e.

9 The above relationships are shown in the graphs of Figs. 2  
10 (A), (B), (C). Fig. 2 (A) shows the relationship of object Lux  
11 (abscissa) and video output voltage (ordinate) of the prior  
12 device (dotted line) compared with this invention. The hatched  
13 lines shows the broadened range for photographs in this  
14 invention. Fig. 2 (B) shows the relationship of object Lux  
15 (abscissa) and S/N ratio (ordinate) of this invention. Fig. 2  
16 (C) shows the relationship of object Lux (abscissa) and gain of  
17 auxiliary amplifying circuit m (ordinate) of this invention. In  
18 the prior device, as shown in Fig. 2 (A), dotted line indicates  
19 the prior device, photographing is impossible at object Lux of  
20 0.02 Lux (S/N ratio is 40 dB).

21 In this invention, as shown in Fig. 2 (C), the object Lux  
22 is lower than 0.02 Lux, the amplification degree increases, and  
23 photographing is possible until an object of Lux 0.002 Lux. But  
24 the S/N ratio is lowered to 25 dB as shown in Fig. 2 (B).

25 Second Embodiment.

1 Fig. 3 shows the second embodiment of this invention.

2 *ins*  
3 *A3* As shown in Fig. 2, in the second embodiment, in signal  
4 processing circuit d of video camera using a CCD, area sensor  
5 etc. an automatic gain control auxiliary amplifying circuit  $m_1$   
6 of high S/N ratio amplification degree 0 dB to 26 dB and an  
7 automatic gain control auxiliary amplifying circuit  $m_2$  of low  
8 S/N ratio amplification degree 0 dB to 46 dB are provided.  
9 According to necessity, it is possible to selectively using  
10 automatic gain control auxiliary amplifying circuit  $m_1$  of high  
11 S/N ratio or automatic gain control auxiliary amplifying circuit  
12  $m_2$  of low S/N ratio by switch S.  $V_{DD}$  is an electric source.

13 As shown in Fig. 2 (C), the object illumination is higher  
14 than 0.02 Lux, amplification degree automatic gain control  
15 auxiliary amplifying circuit  $m_1$  of high S/N and low  
16 amplification degree 0 dB to 26 dB works. For an object  
17 illumination lower than 0.02 Lux, high amplification degree  
18 automatic gain control auxiliary amplifying circuit  $m_2$  works,  
19 and the amplification degree increases. However the S/N ratio  
20 is lower than 25 dB as shown in Fig. 2 (B).

21 Third Embodiment.

22 Fig. 4 shows the third embodiment of this invention.

23 As shown in Fig. 4, in the third embodiment, two automatic  
24 gain control auxiliary amplifying circuits  $m_1$   $m_2$  are provided in  
25 one AGC amplifying circuit em and their amplification degrees  
are changed by switch S and voltage or current.

1 Maximum amplification degrees are 0 dB to 26 dB and 0 dB to  
2 46 dB and their amplification degrees are selected by switch S.  
3 Level of entering light are detected by level detecting circuit  
4 r and controls the switch S and set the amplification degree to  
5 a suitable value.

6 As explained in the construction, the same effects are  
7 accomplished.

8 Effect of this invention.

9 According to this invention, in the case of sufficiently  
10 bright object, photographing is performed by conventional  
11 circuit, in the case of insufficient bright object, inserting  
12 auxiliary amplifying circuit  $m$ ,  $m_1$ ,  $m_2$  or  $em$ , ignoring the S/N  
13 ratio, and raising the amplification degree, in the case of a  
14 sufficient bright object, photographing is performed by high S/N  
15 ratio, and high degree, in the case of insufficient bright  
16 object, inserting auxiliary amplifying circuit  $m$ ,  $m_1$ ,  $m_2$  or  $em$ ,  
17 and ignoring S/N ratio, utility photographing is possible.  
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